▶ to divide using polar form:

$$\frac{z_1}{z_2} = \frac{r_1 e^{i\theta_1}}{r_2 e^{i\theta_2}} = \frac{r_1}{r_2} e^{i(\theta_1 - \theta_2)}$$

(divide modulus, subtract argument)

ex $z = 1 - i\sqrt{3}$, find z^5 and $1/z^2$

$r = 2$ $\theta = -\pi/3$ → polar form: $z = 2e^{i(-\pi/3)}$

▷ so, multiply the modulus and add argument to find z^5

$= 2^5 e^{i5(-\pi/3)}$

$= 32 e^{-i\frac{5\pi}{3}}$ ⟶ $\theta = -\frac{5\pi}{3} + 2\pi = \pi/3$

$= \boxed{32e^{i\pi/3}}$

▷ $\frac{1}{z^2} = \frac{1 \cdot e^{i0}}{2^2 e^{i2(-\pi/3)}} = \frac{1}{2^2} e^{i(0 - 2(-\pi/3))} = \frac{1}{4} e^{i\frac{2\pi}{3}}$

For i

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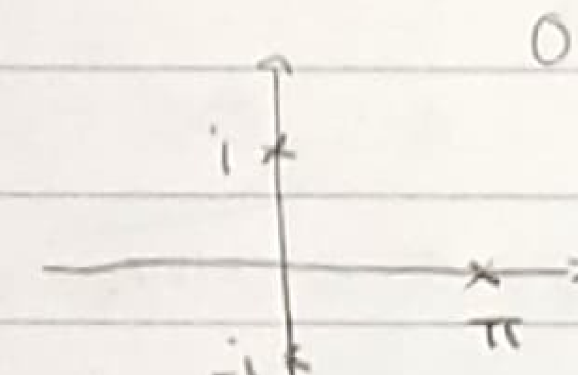
$i = r\text{cis}(\theta)$ → $r = 1$ $\theta = \pi/2$ $i = 1\text{cis}(\pi/2)$

$-i$ → $r = 1$ $\theta = -\pi/2$ $-i = \text{cis} -\pi/2$



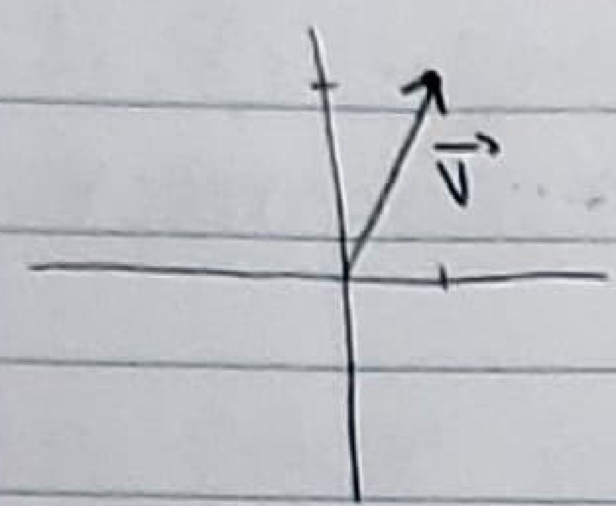
$-8i = 8\text{cis}(-\pi/2)$ remember r can't be negative

$\pi = \pi\text{cis}(0)$

Vectors

- similar to numbers (1, 2, 3, 4 ...)
  - vectors: group in pairs → $\underbrace{(1,2)\ \ (5,-4)\ \ (-1,\sqrt{2})}_{\text{2-component vectors}}$

- a vector represents a point on the plane ex $\vec{v} = (1,2)$



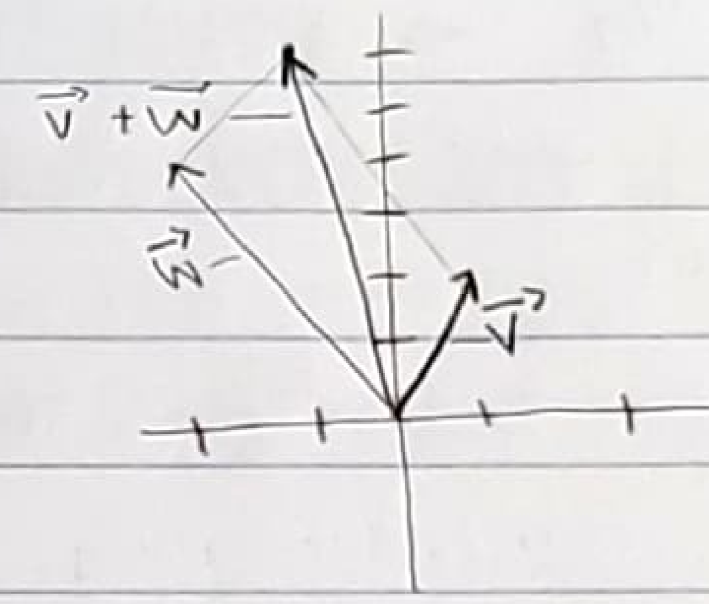
(1,2) is the coordinate point, to draw $\vec{v}$
draw → from origin to point

- vectors are used to describe <u>quantity</u> and <u>direction</u>

Operations of vectors

$\vec{v} = (1,2)$ $\qquad$ $\vec{w} = (-2,4)$

x-comp, y-comp



makes a parallelogram

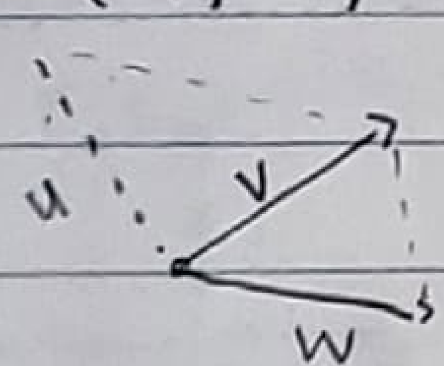
addition $\vec{v} + \vec{w} = (1+-2,\ 2+4) \rightarrow (-1,6)$

↳ just add the components

★ $\vec{v}+\vec{w}$ can be computed by adding components and replicated by the parallelogram rule ★

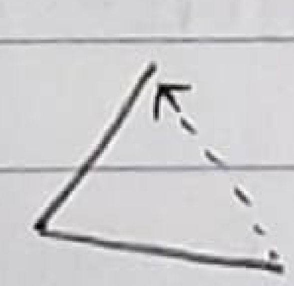
Subtraction $\vec{v} = (1,2)$ $\quad$ $\vec{w} = (2,3)$

$\underbrace{\vec{v} - \vec{w}}_{\vec{u}} = (-1,-1)$



parallelogram rule again since u + w = v

so connect tip to tip
then move to origin



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- $\vec{v}$ can be written as $\langle x, y \rangle$
- all vectors that have the same x, y coordinates are equivalent to each other.

Vector zero

$\vec{0} - \vec{v} = -\vec{v}$ (reflected about the origin)

$\vec{0} = \langle 0,0 \rangle$

$\vec{v} \pm \vec{0} = \vec{v}$